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PRE-APPEAL BRIEF REQUEST FOR REVIEW

Docket Number (Optional)

35121US1

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on May 30, 2006

Signature

Typed or printed name Steven J. Solomon

Application Number

10/691,102

Filed

October 22, 2003

First Named Inventor

Ulrich Kroll

Art Unit

2812

Examiner

Savitri Mulpuri

Applicant requests review of the final rejection in the above-identified application. No amendments are being filed with this request.

This request is being filed with a notice of appeal.

The review is requested for the reason(s) stated on the attached sheet(s).

Note: No more than five (5) pages may be provided.

I am the

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applicant/inventor.

☐

assignee of record of the entire interest.

See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed.
(Form PTO/SB/96)

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May 30, 2006

Date

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required.
Submit multiple forms if more than one signature is required, see below.

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Claims 3 and 4 have been finally rejected as being obvious over Catalano (Pat. No. 4,845,043) in view of Yamazaki (Pat. No. 5,512,102). The Examiner has acknowledged the base reference, Catalano, does not disclose using the compounds recited in claims 3 and 4, respectively, in the claimed operations. The Examiner has relied on Yamazaki to teach the compounds recited in claims 3 and 4. The Examiner has also relied on Yamazaki to suggest it would have been obvious to substitute these compounds for the nitrogen trifluoride (NF₃) used in Catalano as a flush gas to remove residual dopant left in the reaction chamber prior to depositing a second layer.

Specifically, the Examiner has argued that Yamazaki discloses or teaches:

- several nonproductive compounds including water, ammonia and hydrazine "along with nitrogen trifluoride (NF₃) or dinitrogen hexafluoride (N₂F₆) *to provide hydrogen or halogen elements*¹ (see col. 2, lines 42-51);" and
- cleaning the surface of the substrate by providing active hydrogen or fluorine or chlorine to remove contaminants before growing a semiconductor layer, citing col. 13, line 62 to col. 14, line 7.

Based on these assertions, the Examiner then reasons:

Since Yamazaki teaches water or ammonia or hydrazine or nitrogen fluoride² are the compounds as art recognized equivalents to generate active hydrogen or halogen to remove contaminants, nitrogen fluoride can be replaced with either water (as in claim 3) or ammonia or hydrazine (as in claim 4) in the invention of Catalano to remove the contaminants.

Final Office action, page 3.

Basically, the pending rejection stands or falls with the Examiner's ultimate conclusion that "Yamazaki teaches ammonia or water or hydrazine are functionally equivalent to nitrogen trifluoride [which is used in Catalano]" to remove residual dopant gas from the CVD chamber in between layer deposition steps. See Advisory action, Continuation of 11. Interestingly, the "active hydrogen/fluorine" referred to in Yamazaki and cited by the Examiner is not used to remove residual dopant from the CVD chamber; it is used to remove oxides or dust from the substrate surface. See col. 13, line 62 to col. 14, line 7.

¹ See FN 3 below.

² It is understood that by "nitrogen fluoride," the Examiner intends fluorides of nitrogen generally, including NF₃ as used in Catalano, which is commonly referred to as nitrogen *tri*fluoride.

A careful review of Yamazaki reveals that reference does not even imply equivalence as the Examiner suggests. In Yamazaki, water, hydrazine and ammonia are in no way disclosed or suggested, or even implied, to be equivalent to NF_3 , for removing residual dopant material.

To understand Yamazaki in the context of the rejection, it is necessary first to understand the process described in that reference. Yamazaki discloses an improvement for a plasma chemical vapor deposition ("plasma CVD") process for depositing semiconductor layers. Specifically, the manner of generating the deposition plasma is modified from the typical manner to produce the plasma. In Yamazaki, the material that is reacted in the plasma state to produce solid deposition material is referred to as the "productive gas." That reference also employs a "non-productive gas," so-called because it does not react while in the gas/plasma state to produce solid reaction products that can become deposited during the deposition process. (See col. 2, lines 42-45 of Yamazaki).

To deposit material produced from the productive gas, the productive gas must first be excited (energized) to form a plasma. In Yamazaki, excitation of the productive gas is not done directly, for example using a radio frequency or DC power source as is conventional. Instead, a different, "nonproductive gas" is separately energized in a resonant space that is separate from the CVD reaction chamber. To energize the nonproductive gas, it is radiated with microwaves at a selected frequency in the presence of an applied magnetic field, e.g. using a cyclotron. (See Yamazaki, col. lines 42-51 and col. 3, lines 40-64). Once the nonproductive gas has been excited (energized), it is delivered into the CVD reaction chamber where it is mixed with the productive gas. In the CVD chamber, the energized nonproductive gas interacts with the initially un-energized productive gas, to impart energy thereto, thereby exciting the productive gas and producing a productive gas plasma. This process is described in Yamazaki at col. 3.

As the nonproductive gas (i.e. that will not react to produce solid material), Yamazaki notes that various noble gases may be used, but that it also "may be an oxide gas such as oxygen, nitrogen oxide (N_2O , NO , NO_2), carbon oxide (CO , CO_2), water (H_2O) or a nitride such as nitrogen, ammonia, hydrazine (N_2H_4) or nitrogen fluoride (NF_3 , N_2F_6) or a mixture thereof diluted with a carrier gas or hydrogen gas." Col. 2, lines 42-51.

Based on this, the Examiner has argued that col. 2, lines 42-51 of Yamazaki disclose that water, ammonia or hydrazine can be used interchangeably with NF_3 to supply "active hydrogen" that can be used to remove contaminants from a substrate surface. Office action, p. 3. But this is

not what the cited passage says. Instead, that passage merely indicates these materials all can be used as the nonproductive gas, which is initially excited outside the CVD chamber and then introduced therein to interact with and excite the productive gas. The passage says nothing about the interchangeability of these materials to produce active hydrogen to clean the substrate. That passage is totally unconcerned with the substrate, or with cleaning it. Certainly it does not disclose or even imply that water, ammonia or hydrazine are "art recognized equivalents to generate active hydrogen or halogen to remove contaminants" as the Examiner has argued.

In fact, Yamazaki does not anywhere teach or suggest that water, ammonia or hydrazine can generate active hydrogen useful for decontamination of substrates. All it says at col. 2, lines 42-51 is that these materials may be used as a nonproductive gas that can be separately energized and then mixed with the productive gas, in order to produce a productive gas plasma as mentioned above. The specific reaction products of the nonproductive gases, and their potential uses or functions, are not even considered in Yamazaki, except that they must not be solid. It is noteworthy in the cited passage Yamazaki says the nonproductive gas, including water, hydrazine or ammonia if used, is "diluted with a carrier gas or hydrogen gas." If the function of any of these is to produce active hydrogen as the Examiner suggests, why then dilute and supply it with hydrogen gas to begin with? The fact is, Yamazaki merely points out that one or a mixture of these compounds may be useful as a nonproductive gas, capable of being excited and then introduced into the CVD chamber to excite the productive gas to produce a productive gas plasma -- nothing more.

The Examiner's discussion of "active hydrogen," and of the above-mentioned compounds to produce it, apparently comes from col. 13, line 62 to col. 14, line 7. There, in Experiment 14 the substrate surface is cleaned using active hydrogen, fluorine or chlorine atoms as part of a photo cleaning step, prior to growth of a semiconductor layer. But there is no connection between the use of active hydrogen, chlorine or fluorine at cols. 13-14 for decontaminating a substrate, and the nonproductive gases described in col. 2. Nowhere are the nonproductive gases disclosed to be reactants/precursors for producing the active hydrogen/chlorine/fluorine used in Experiment 14 to clean the substrate. They are certainly not used this way in Yamazaki.

In summary, the basis for the present rejection is as follows:

1. NF_3 and water/ammonia/hydrazine are candidate nonproductive gases in Yamazaki,

and therefore are interchangeable³;

2. NF_3 is the gas used in Catalano to remove diborane dopant from the CVD reaction chamber;

3. Therefore, water/ammonia/hydrazine must be interchangeable with NF_3 in Catalano.

This logic is flawed, at least because neither reference teaches or suggests interchangeability of water/ammonia/hydrazine with NF_3 to remove diborane in Catalano's flushing step. Yamazaki merely says that water, ammonia and hydrazine, like NF_3 , are candidates for the nonproductive gas. To the extent this implies some interchangeability, it is only in that all four will not produce solids during the CVD reaction/deposition step that can become deposited onto the substrate. There is certainly no basis in Yamazaki to consider them interchangeable for the purpose of reacting with/removing residual dopants from the CVD chamber in between deposition steps. It is not even clear the nonproductive gas in Yamazaki is present in between deposition steps (as opposed to during them).

Furthermore, in Yamazaki a doping agent such as B_2H_6 (diborane -- the dopant used in Catalano) can be mixed and supplied with the nonproductive gas. See col. 2, lines 59-60. It makes no sense to interpret Yamazaki as teaching the nonproductive gas can be used to remove residual doping agent left *after* a deposition step, when that gas is supplied *during* the deposition step and with the doping agent mixed in.

Lastly, the Examiner cites col. 1, lines 45-54 as teaching the use of hydrogen or halogen doping to neutralize recombination centers. Recombination centers are locations in the semiconductor layer where opposite charge carriers (electrons and holes) may be recombined, for example due to impurities or charge point defects. The use of hydrogen or halogen as a dopant in the semiconductor layer to neutralize such recombination centers has nothing to do with cleaning the substrate surface or removing residual doping agent from the CVD chamber.

³ It is unclear how the Examiner concludes all of these will produce active hydrogen/fluorine to decontaminate the substrate surface in Experiment 14. Even if true, the time to decontaminate that surface is not while semiconductor material is being deposited on that surface, which is when the nonproductive gas is supplied.